

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
5 August 2004 (05.08.2004)

PCT

(10) International Publication Number
WO 2004/066298 A1

(51) International Patent Classification⁷: **G11B 20/10**

(21) International Application Number:
PCT/KR2004/000113

(22) International Filing Date: 24 January 2004 (24.01.2004)

(25) Filing Language: Korean

(26) Publication Language: English

(30) Priority Data:
10-2003-0004930 24 January 2003 (24.01.2003) KR

(71) Applicant (for all designated States except US): **LG ELECTRONICS INC.** [KR/KR]; 20, Yoido-dong, Youngdungpo-gu, Seoul 150-010 (KR).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **SUH, Sang Woon** [KR/KR]; 110-709, Hyundai Apt., 1346, Seocho, 2-dong, Seocho-gu, Seoul 137-861 (KR). **KIM, Jin Yong** [KR/KR]; 109-602, Seonkyung Apt., Yatap-dong, Bundang-gu, Seongnam, Kyunggi-do 463-928 (KR).

(74) Agent: **PARK, Lae Bong**; 1Fl., Dongun Bldg., 413-4, Dongok 2-dong, Kangnam-gu, Seoul 135-272 (KR).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

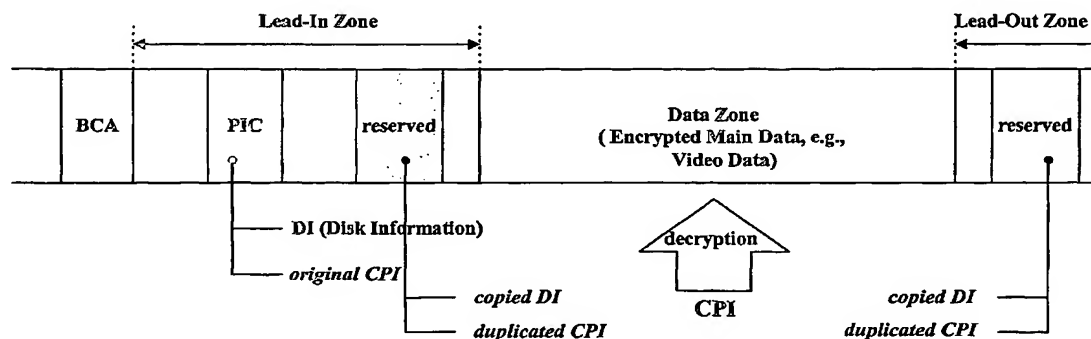
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD OF MANAGING COPY PROTECTION INFORMATION OF A RECORDING MEDIUM, RECORDING MEDIUM WITH COPY PROTECTION INFORMATION FOR CONTENTS RECORDED THEREON, AND REPRODUCING METHOD FOR THE RECORDING MEDIUM



(57) Abstract: The present invention relates to a method of managing CPI (Copy Protection Information) for preventing unauthorized copy of encrypted content recorded on a high-density recording medium such as a BD-ROM (Blu-ray Disc ROM). In the present method, when main content data is recorded in encrypted manner, CPI that is necessary to decrypt the encrypted main content data is written in a predetermined PIC area and is also copied at least once in an area other than the PIC area.

WO 2004/066298 A1

DESCRIPTION

METHOD OF MANAGING COPY PROTECTION INFORMATION OF A RECORDING MEDIUM, RECORDING MEDIUM WITH COPY PROTECTION INFORMATION FOR CONTENTS RECORDED THEREON, AND REPRODUCING METHOD FOR THE RECORDING MEDIUM

1. Technical Field

The present invention relates to a method of managing copy protection information (CPI) for preventing an illegal copying of encrypted contents recorded on a high-density recording medium such as a BD-ROM (Blu-ray Disc ROM), a recording medium having the copy protection information stored thereon, and a method of reproducing the recording medium.

2. Background Art

The standardization of new high-density optical disks capable of recording large amounts of high-quality video and audio data has been progressing rapidly and new optical disk related products are expected to be commercially available on the market in the near future. The Blu-ray Disc Rewritable (called 'BD-RE' in general) is one example of these new optical disks.

As shown in FIG. 1, a BD-RE disk comprises a clamping area, a transition area, a burst cutting area (BCA), a lead-in area, a data area, and a lead-out area in order starting from the innermost circumference.

The lead-in area comprises several pre-assigned areas such as a first guard (Guard 1) area, a permanent information & control data (PIC) area, a second guard (Guard 2) area, a second information (Info 2) area, and an optimum power calibration (OPC) area. The Guard 1 area and the PIC area are pre-recorded areas in which some initial data is pre-recorded,

whereas the other areas of the lead-in area, the data area, and the lead-out areas are all rewritable areas.

In the PIC area, important information about the disk, which is to be preserved permanently, is encoded in a wobbled 5 groove by high frequency modulation (HFM). As shown in FIG. 2, the wobble-shaped data encoding is performed by bi-phase modulation.

In the mean time, the development of the read-only Blu-ray disk (BD-ROM) is also under way along with the development 10 of the BD-RE. A BD-ROM disk comprises an inner area, a clamping area, a transition area, an information area, and a rim area, as shown in FIG. 3.

The contents of A/V streams are recorded in the data zone belonging to the information area in an encrypted manner using 15 the copy protection information (CPI) with a view to preventing an illegal copying of the contents.

Disc information (DI) such as disc type is recorded in the PIC area belonging to the information area. In the case where the main data recorded in the data zone is encrypted, 20 copy protection information (CPI) for decrypting the encrypted data is also recorded in the PIC area.

When an optical disk (a BD-ROM disk) is loaded into an optical disk reproducing apparatus, the optical disk reproducing apparatus first detects the copy protection 25 information (CPI) recorded in the PIC area and then decrypts the main data recorded in the data zone using the copy protection information (CPI) if the main data is encrypted.

If an error occurs when the apparatus detects the copy protection information (CPI), which is required to decrypt the 30 encrypted data, the contents of the BD-ROM disk cannot be decoded even if there is no data read error.

3. Disclosure of the Invention

It is one object of the invention to provide a method of recording copy protection information on a recording medium 35 that allows reliable read-out of the copy protection information for decrypting contents recorded on thereon.

It is another object of the present invention to provide a recoding medium having copy protection information for decrypting encrypted contents recorded thereon.

It is still another object of the present invention to provide a method of reproducing and decrypting encrypted contents recorded on a recording medium by using copy protection information recorded thereon.

A method of recording copy protection information on a recording medium in accordance with the present invention comprises recording encrypted data on the recording medium, and recording the copy protection information required for decrypting the encrypted data in a predetermined first area and additionally in an area other than the first area at least once.

A recording medium in accordance with the present invention comprises a data area storing encrypted data, a first area storing copy protection information required for decrypting the encrypted data, and at least one second area storing a duplicate of the copy protection information.

A method of reproducing a recording medium by a disk reproducing apparatus in accordance with the present invention comprises the steps of (a) driving the recording medium storing encrypted data, (b) detecting copy protection information, which is required for decrypting the encrypted data, recorded in a first area of the recording medium, and (c) if an error occurs in the detection of the copy protection information, detecting duplicated copy protection information from an area other than the first area and decrypting the encrypted data using the detected copy protection information.

The method of recording and reproducing the copy protection information of a recording medium in accordance with the present invention allows encrypted data recorded on the recording medium to be reproduced normally even when the copy protection information cannot be read from the PIC area in which the copy protection information is supposed to be recorded, due to scratches, finger prints, etc.

4. Brief Description of the Drawings

In the drawings:

FIG. 1 illustrates the structure of a BD-RE disk;

FIG. 2 illustrates a high-frequency modulated (HFM) groove formed in the PIC area of the BD-RE disk;

5 FIG. 3 illustrates areas assigned in a BD-ROM disk;

FIG. 4 illustrates disk information (DI) and copy protection information (CPI) recorded in the PIC area of the BD-ROM disk;

FIG. 5 shows an example in which the copy protection information (CPI) is written more than twice in accordance with the present invention;

FIG. 6 illustrates the structure of the disk information table including a duplicate of the copy protection information (CPI) in accordance with the present invention;

15 FIG. 7 illustrates a brief block diagram of an optical disk reproducing apparatus in which the present invention may be advantageously embodied; and

FIG. 8 illustrates an embodiment of a method of reproducing a recording medium in accordance with the present invention.

5. Best Mode for Carrying Out the Invention

In order that the invention may be fully understood, preferred embodiments thereof will now be described with reference to the accompanying drawings.

25 A BD-ROM disk in accordance with the invention has a disk structure comprising an inner area, a clamping area, a transition area, an information area, and a rim area, as shown in FIG. 3.

The data zone assigned in the information area stores moving picture contents such as movies. As shown in FIG. 4, the PIC area assigned in the data zone stores the disk information, which is general information about the disk, and the copy protection information (CPI), which is required to decrypt contents recorded in the data zone in an encrypted manner. In case of a BD-ROM disk, the data recording is conducted by forming pre-pits on the surface of the BD-ROM

disk.

The disk information and CPI stored in the PIC area is recorded as straight pits, or wobbled pits, or partly as wobbled pits and partly as straight pits.

5 The CPI stored in the PIC area, which is a key value used to encrypt the main data recorded in the data zone, is duplicated at least once in areas other than the PIC area.

FIG. 5 shows an example in which the CPI is written additionally in areas other than the PIC area.

10 In FIG. 5, the duplicated CPI is found in a reserved area of the lead-in area and in a reserved area of the lead-out area. In FIG. 5, the disk information as well as the CPI is duplicated in these areas.

The CPI may be duplicated at least once only in the lead-
15 in area, at least once only in the lead-out area, or at least once both in the lead-in area and in the lead-out area.

The areas on a BD-ROM in which the CPI is to be duplicated may be specified by the BD-ROM standard or may vary depending on manufacturers. In the latter case, information on
20 the position of each duplicated CPI is included in the disk information table.

FIG. 6 shows the structure of the disk information table in accordance with the present invention. The disk information table includes various types of information on the disk,
25 including a disk information identifier, disk size/version, and disk structure. In addition, the disk information table includes information on respective duplicated CPI positions (CPI_position) in a reserved field.

The size of the position information (CPI_position) is
30 proportional to the number of the duplicated CPIs. If information on the position of each duplicated CPI is assigned 4 bytes and there are N duplicated CPIs, the size of the position information (CPI_position) is $4 \times N$ bytes.

In the case where the disk information is duplicated
35 along with the CPI in the lead-in area and/or lead-out area, the information on the respective CPI positions is also duplicated.

FIG. 7 illustrates a brief block diagram of an optical disk reproducing apparatus in which the present invention may be advantageously embodied. The apparatus, which comprises an optical pickup 11 for reading optical information from a BD-ROM disk, a VDP (video disc play) system 12 for signal processing and servo control, and a D/A converter 13, decrypts the contents recorded on the BD-ROM disk using the copy protection information and outputs A/V signals by following a procedure illustrated in FIG. 8.

10 If a BD-ROM disk having copy protection information stored thereon is inserted into the apparatus (S10), the VDP system 12 rotates the BD-ROM and controls the optical pickup 11 to search the PIC area of the BD-ROM for the CPI and disk information (S11)

15 If an error occurs when reading the CPI (S12), the VDP system 12 checks if there is an error in the disk information (S13). If no error is found (S13-1), the VDP system 12 reads information on duplicated CPI positions (CPI_position) recorded in the disk information (S14) and then reads the CPI
20 by moving the optical pickup 11 to a position where a duplicated CPI is written (S15). If a read error occurs again, the VDP system 12 moves the optical pickup 11 to a next position where a duplicated CPI is written and reads the CPI recorded therein (S16).

25 If the disk information read from the PIC area has an error (S13-1), the optical disk reproducing apparatus reads information on the position of CPI and/or disk information stored in a predetermined position of the apparatus (S20) and reads the CPI by moving the optical pickup 11 to the position
30 (S21).

If the CPI is detected normally, the VDP system 12 moves the optical pickup 11 to the data zone from which to begin reproducing encrypted contents and decrypts the reproduced contents using the CPI (S17). And the VDP system 12 decodes
35 the decrypted contents and finally outputs A/V signals (S18).

The described method of recording and reproducing the copy protection information for a recording medium allows

encrypted data recorded on the recording medium to be reproduced normally even when the copy protection information cannot be read from the PIC area due to scratches, finger prints, etc.

5 While the invention has been disclosed with respect to a limited number of embodiments, those skilled in the art, having the benefit of this disclosure, will appreciate numerous modifications and variations therefrom. It is intended that all such modifications and variations fall
10 within the spirit and scope of the invention.

CLAIMS

1. A method of recording copy protection information on a recording medium, comprising:

recording encrypted data on the recording medium; and

5 recording copy protection information required for decrypting the encrypted data in a predetermined first area and additionally in a second area other than the first area at least once.

2. The method set forth in claim 1, wherein the first
10 area is a PIC area defined in the recording medium.

3. The method set forth in claim 1, wherein the second area includes an area exclusive of a PIC area within a lead-in area defined in the recording medium.

4. The method set forth in claim 1, wherein the second
15 area includes a lead-out area defined in the recording medium.

5. The method set forth in claim 1, wherein disk information about the recording medium is recorded in the PIC area defined in the recording medium and the disk information is duplicated also in the area other than the first area.

20 6. The method set forth in claim 1, wherein disk information about the recording medium is recorded in a PIC area defined in the recording medium and position information for the copy protection information recorded in the second area is recorded in the disk information.

25 7. A recording medium, comprising:

a data area storing encrypted data;

a first area storing copy protection information required for decrypting the encrypted data; and

at least one second area storing a duplicate of the copy
30 protection information.

8. The recording medium set forth in claim 7, wherein the first area is a PIC area defined in the recording medium.

9. The recording medium set forth in claim 7, wherein the second area includes an area exclusive of a PIC area within a

lead-in area defined in the recording medium.

10. The recording medium set forth in claim 7, wherein the second area includes a lead-out area defined in the recording medium.

5 11. The recording medium set forth in claim 7, wherein the first area stores position information for the copy protection information duplicated in the second area.

12. A method of reproducing a recording medium by a disk reproducing apparatus, comprising the steps of:

- 10 (a) driving the recording medium storing encrypted data;
(b) detecting copy protection information, which is required for decrypting the encrypted data, recorded in a first area of the recording medium; and
(c) if an error occurs in the detection of the copy
15 protection information, detecting duplicated copy protection information from a second area other than the first area and decrypting the encrypted data using the detected copy protection information.

13. The method set forth in claim 12, wherein the first
20 area is a PIC area defined in the recording medium.

14. The method set forth in claim 12, wherein the second area includes an area exclusive of a PIC area within a lead-in area defined in the recording medium.

15. The method set forth in claim 12, wherein the second
25 area includes a lead-out area defined in the recording medium.

16. The method set forth in claim 12, wherein the step
(c) detects position information for the duplicated copy protection information included in disk information for the recording medium and reads the duplicated copy protection
30 information from the position to decrypt the encrypted data.

17. The method set forth in claim 12, wherein the step
(c) detects position information for the duplicated copy protection information stored in a predetermined position in the apparatus and reads the duplicated copy protection
35 information from the position to decrypt the encrypted data.

18. The method set forth in claim 12, wherein, if the detection of the duplicated copy protection information fails,

the step (c) detects duplicated copy protection information from another area.

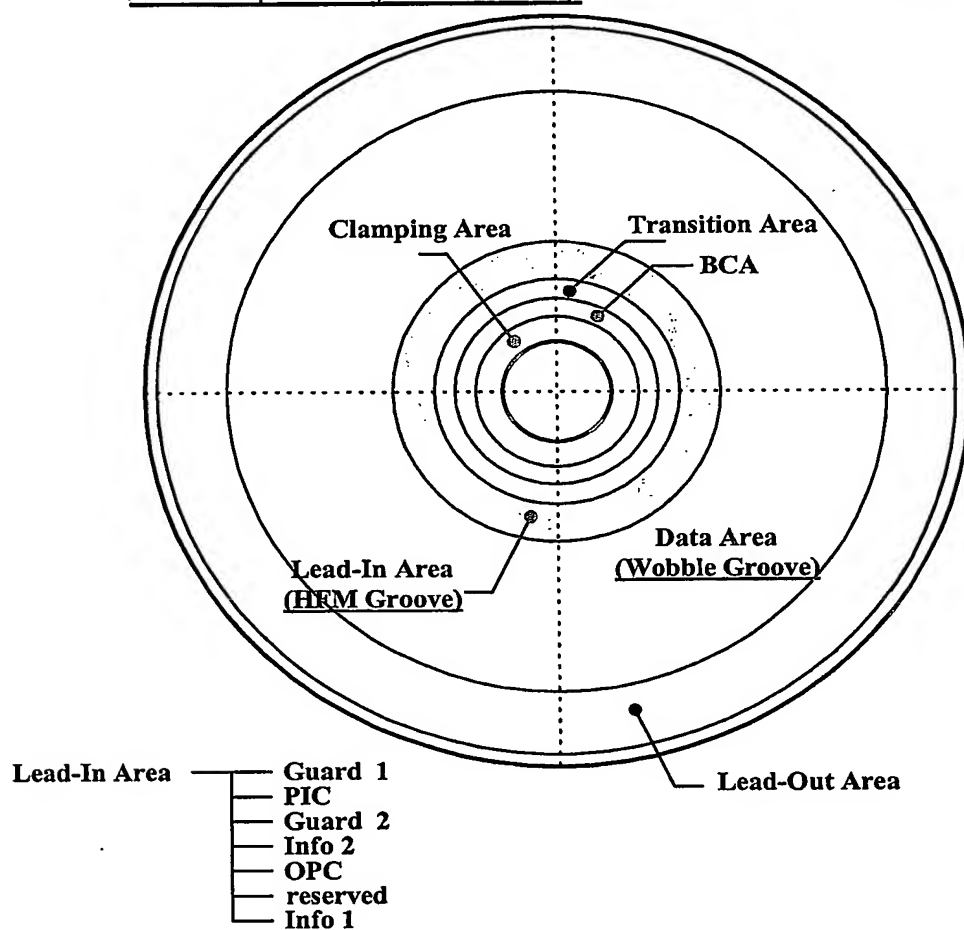
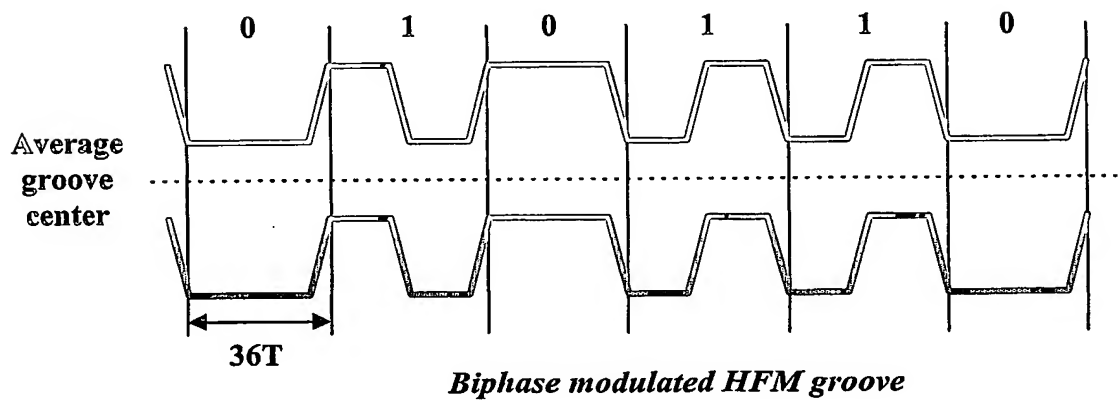
BD-RE (Blu-ray Rewritable)**FIG. 1****FIG. 2**

FIG. 3***BD-ROM (Blu-ray ROM)***

Inner area			
Clamping area			
Transition area			
Information area	Information zone	Lead-In zone	protection zone 1
			PIC
			protection zone 2
			INFO 2
			reserved
			INFO 1
		Data zone	
		Lead-Out zone / Outer zone	INFO 3/4
			protection zone 3
		Rim area	

FIG. 4

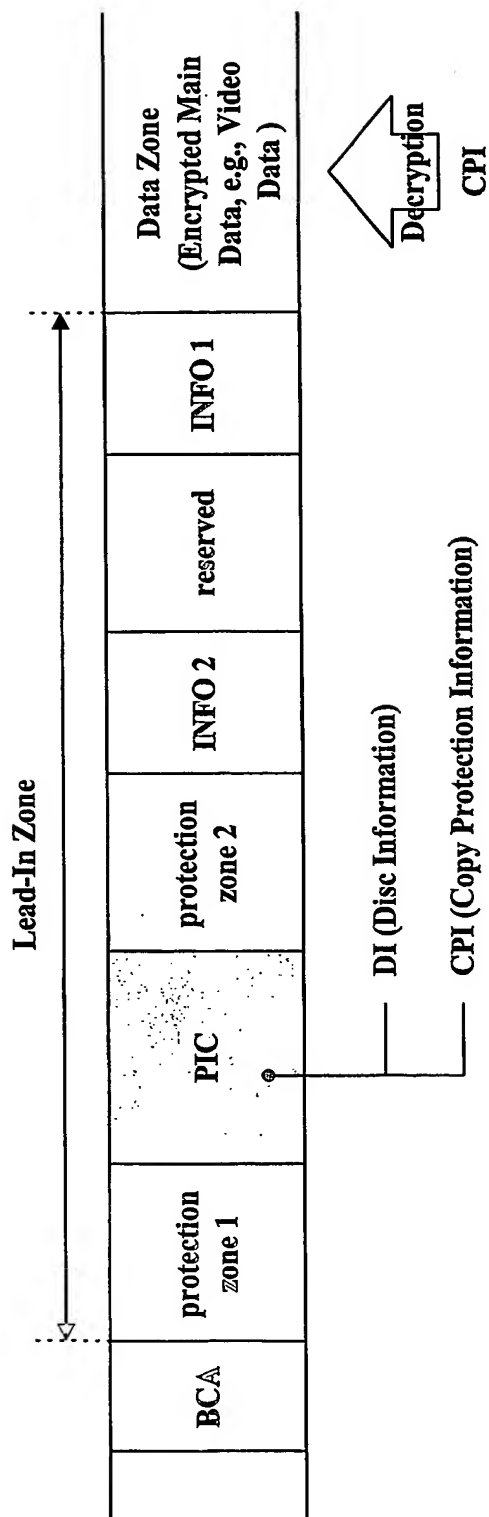


FIG. 5

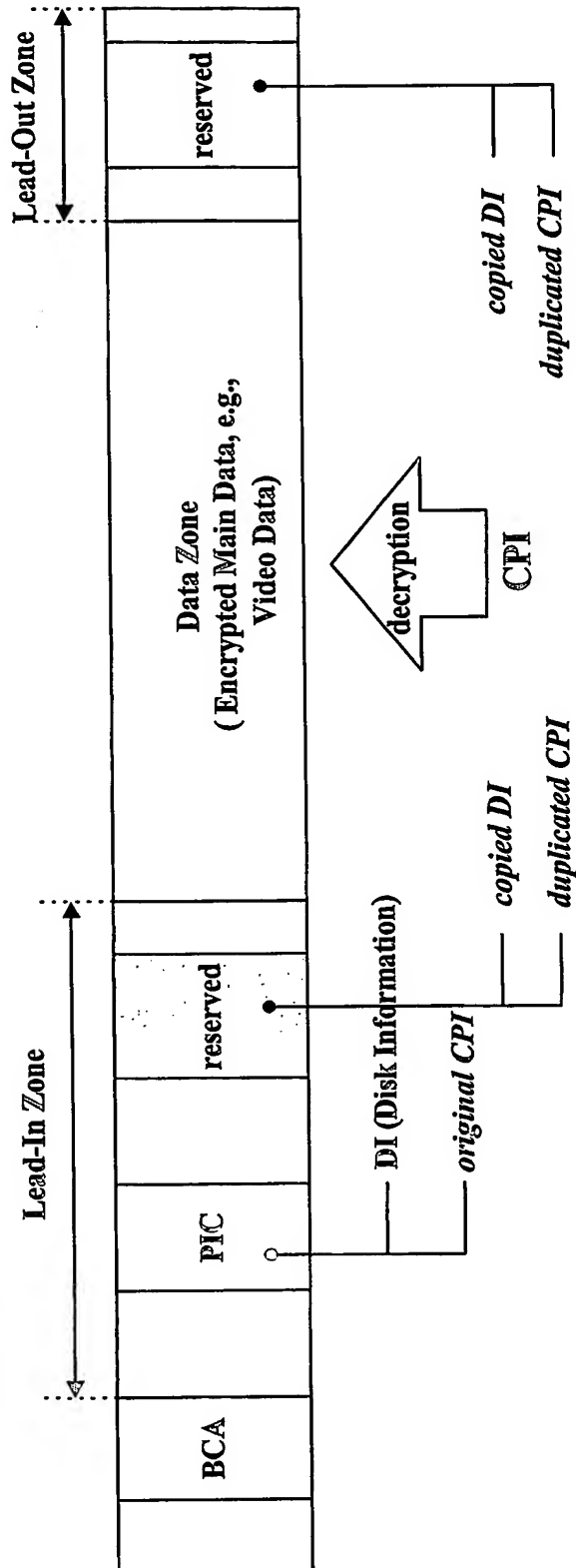


FIG. 6

Byte number	Contents	number of bytes
0	Disc Information identifier = "DI"	2
2	DI format	1
3	Reserved = 00h	1
4	Number of DI frames in each DI Block	1
5	DI Frame sequence number in DI Block	1
6	Number of DI bytes in use in this DI Frame	1
7	Reserved = 00h	1
8 to 10	disc type identifier = "BDO"	3
11	disc size / version	1
12	disc structure	1
13	channel bit length	1
14 to 15	Reserved = all 00h	2
16	BCA descriptor	1
17	maxium transfer rate of application	1
18 to 23	Reserved = all 00h	6
24 to 31	Data zone allocation	8
32 to 111	Reserved = all 00h	13

where information on respective CPI positions is written

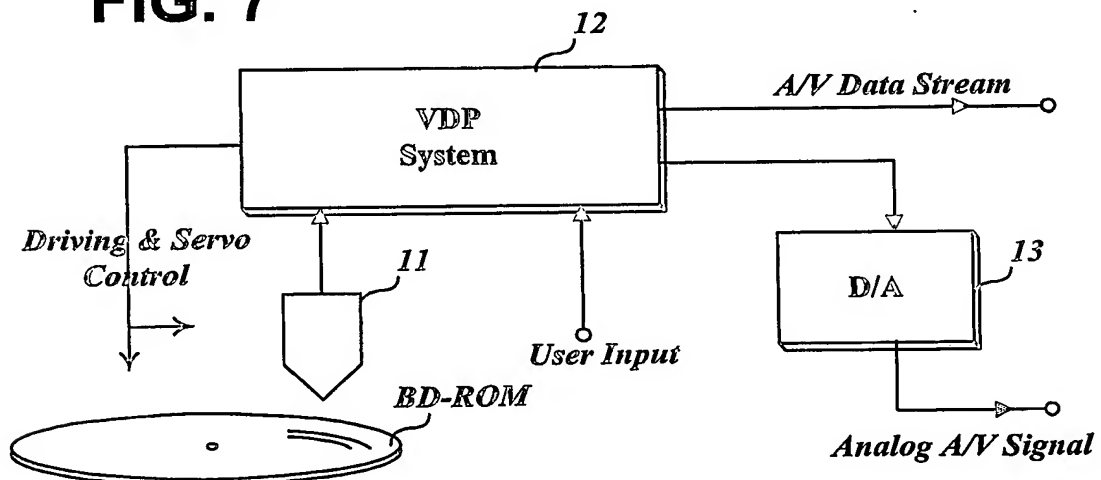
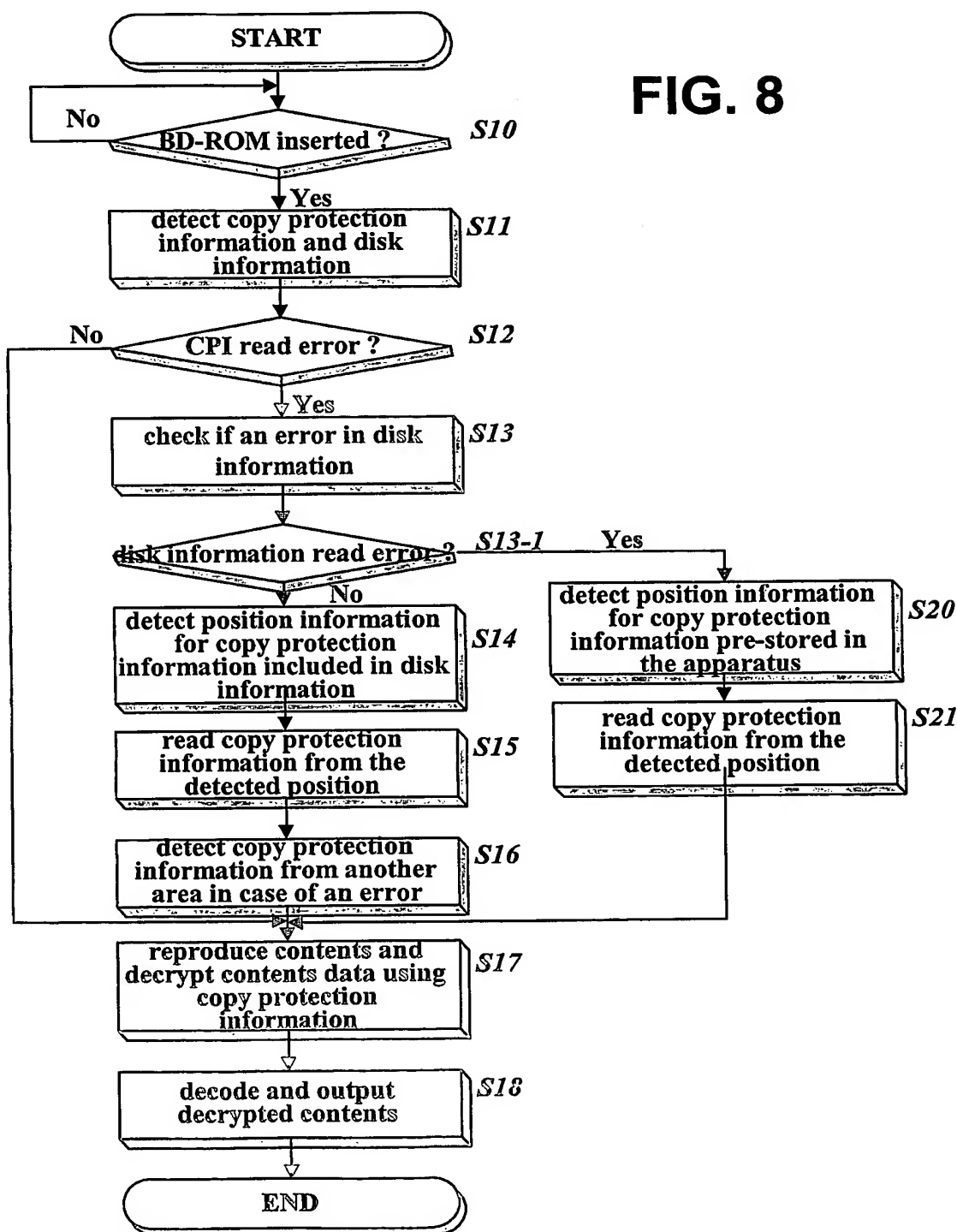
FIG. 7

FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.

P/KR2004/000113

A. CLASSIFICATION OF SUBJECT MATTER**IPC7 G11B 20/10**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G11B 20/10 G11B 20/12 G11B 7/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Patents and applications for inventions since 1975

Korean Utility models and applications for utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

"encrypt*", "decrypt*", "scramble", "key", "copy protect"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6,289,102 B1 (MATSUSHITA) 11 SEP 2001 See the whole document	1-18
A	US 6,031,815 A (U.S. PHILIPS) 29 FEB 2000 See the whole document	1-18
A	EP 0936610 A2 (SONY) 18 AUG 1999 See the whole document	1-18
A	US 2001/0036132 A1 (SONY) 01 NOV 2001 See the whole document	1-18

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

06 MAY 2004 (06.05.2004)

Date of mailing of the international search report

06 MAY 2004 (06.05.2004)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
920 Dunsan-dong, Seo-gu, Daejeon 302-701,
Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

HAN, Choong Hee

Telephone No. 82-42-481-5700

